

**PRELIMINARY
Health
Assessment
for**

[REDACTED]

MONSANTO CHEMICALS (SODA SPRINGS)

SODA SPRINGS, IDAHO

CERCLIS NO. IAD081830994

[REDACTED]

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SUMMARY

*to Soda Creek
which is subsequently used for
agricultural irrigation*

The Monsanto Chemical Company, located in Soda Springs, Idaho has been proposed for inclusion on the National Priorities list. This plant processes locally mined phosphate ore to produce elemental phosphorus. The active plant occupies 530 acres and is located approximately one mile north of the Town of Soda Springs. Ore is stockpiled on-site prior to being processed for introduction into electric arc furnaces along with coke and silica. All process waters, with the exception of non-contact cooling water, are held and treated on-site and then reused. The non-contact cooling water is discharged ~~from the site and used in~~ agricultural irrigation. The process waters, previously stored in unlined ponds or impoundments, have been implicated as sources of contamination to the local groundwater. Contaminants found both on-site and off-site at levels of potential public health concern include cadmium, selenium, vanadium, and fluoride. Fluoride was found at 6 to 7 ppm in a residential well immediately south of the plant property. All currently active process water impoundments have been lined. Soil from the old ponds has been removed and backfilled with clean cover material. A network of approximately 52 monitoring wells is maintained to assess plume migration. Other potential sources of pollution include waste slag, fugitive dust emissions, and air emissions from ore processing and the electric arc furnaces. The air emissions, which include sulfur oxides and particulates are controlled as required by the State. The current environmental media of concern is the groundwater. Soda Springs' drinking water supply is taken from natural springs located hydraulically upgradient from the Monsanto facility. The one known owner of the contaminated residential well discussed above is currently being supplied municipal water. Also, subsequent to the corrective action being taken by Monsanto, the residential well water has returned to meeting all drinking water standards. The site is of potential public health concern because of possible exposure to contaminants via ingestion, inhalation, and dermal absorption from groundwater use and inhalation from plant air and fugitive dust emissions. Groundwater protection will remain a concern until it can be demonstrated that the contamination source and plume no longer poses a potential health threat. Groundwater monitoring should be continued to support such a determination.

BACKGROUND

A. SITE DESCRIPTION AND HISTORY

The Monsanto facility at Soda Springs, Idaho (see figures 1 and 2 attached) processes locally mined phosphate ore to produce elemental phosphorus. The facility consists of over a dozen administrative and processing buildings plus ore piles, slag piles, byproduct materials, surface impoundments and a waste landfill, on 530 acres located about one mile north of the town, on the west side of State Highway 34. The site was purchased in 1952 by Monsanto who constructed the plant and started

operations. The site is fenced. The closest surface water is Soda Creek located approximately 2,000 feet west of the facility. The plant is currently staffed with about 400 employees. Two of three on-site production wells provide potable water for employee consumption.

Approximately one million tons of phosphate ore are processed through the plant each year. The ore is first "nodulized" in a rotary oxidation kiln where organic contaminants are released and burned. Some fluorides (about 0.7 pounds per hour) are allowably released from this process. Carbon monoxide generated in the final electric arc furnaces is recycled as a supplemental fuel to provide heat for the nodulizing process)

Nodulized ore to be reduced to elemental phosphorus is fed with coke and silica into one of three electric arc furnaces. The process gases contain phosphorus, silicon tetrafluoride and carbon monoxide. The phosphorus is condensed out for recovery and the particulates are removed in a high energy venturi scrubber. The carbon monoxide is cycled back to the nodulizer as described above. Molten slag from the process is periodically tapped from the furnace. The heavy fraction of the slag consisting primarily of metals (iron, vanadium and others) is tapped separately and sold to another company for extraction of the vanadium.

Monsanto has initiated a number of environmental studies to characterize potential impacts from its operations. In 1980 the slag was analyzed for Extraction Procedure (EP) Toxicity parameters established by the Environmental Protection Agency (EPA) and found not to exceed any of the standards. In 1984 Golder Associates was commissioned to evaluate groundwater and surface water impacts resulting from current and past activity. Thirty-one new monitoring wells were installed to supplement seven existing wells. This investigation showed groundwater under the site to be contaminated with fluoride, cadmium, selenium, vanadium and other inorganic species of less concern. The sources of the contamination were found to be the underflow solids pond, the northwest pond, and the hydroclarifier. The underflow solids pond was subsequently abandoned with the upper layer of contaminated soil removed, backfilled with clean material and capped to prevent further migration of contaminants. The northwest pond was also abandoned and is now being operated as a lined general waste landfill. The hydroclarifier has been rebuilt to allow complete and routine inspection for leakage, none of which has been found. A separate plume showing contamination with chloride, sulfate, and vanadium "may" exist in the southeast portion of the site. This plume is hypothesized to originate east of the Monsanto site.

In 1987, Ecology and Environment, Inc. (E. & E.), an EPA contractor, performed further site sampling as part of the site inspection. Contamination was found in monitoring and production wells. (see "Environmental Contamination and other Hazards")

B. SITE VISIT

A site visit was performed by representatives of ATSDR, EPA, and E. & E. on October 4, 1989. Monsanto personnel provided an overview of plant operations, air monitoring programs and water and waste management programs. The area immediately adjacent to the facility boundaries is sparsely populated. About 0.2 miles south of the property line is one residence, the Harris farm, which did have contaminated well water (fluoride at 6 to 7 mg/l). East of the site, immediately across Highway 34 is the Kerr-McGee vanadium processing plant (approximately 60 employees). North of the site is open land and west of the site, near Soda Creek is a naturally carbonated and highly mineralized spring. The spring is a local tourist attraction.

C. COMMUNITY HEALTH CONCERNS

No reports of citizen health concerns were expressed by state or federal officials contacted during the site visit or contained in the file materials that were reviewed. *files contain Harris complaint (6/24/89)*

DEMOGRAPHICS, LAND AND RESOURCE USE

Land use in the vicinity of the Monsanto facility is primarily industrial and agricultural. Population density for the area is sparse. Within one mile of the site there are 27 residents. Within two miles of the site there are about 1,400 residents. Within three miles of the site there are about 3,100 residents, which includes the major portion of the population of Soda Springs (ref. 1). Most of the community residents' water is supplied by the Town of Soda Springs. This water is obtained from springs located to the north of both the town and the subject plant. These springs are believed to be hydraulically upgradient from the Monsanto site (refs. 2 and 3). Twenty two domestic wells are registered within three miles of the Monsanto facility, again many of which are said to be upgradient of the Monsanto site. Seven irrigation wells are registered within three miles of the subject site. The only family known to have been affected by off-site ground water contamination is the Harris family located about 0.2 miles south of the site. This family was subsequently provided city water.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. ON-SITE CONTAMINATION

Groundwater at three production wells on-site and one domestic well off-site were analyzed for EPA Target Compound List organics. None were detected. *THW*

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On-site monitoring wells located downgradient from contamination sources showed elevated ground water concentrations of cadmium, selenium, vanadium, fluoride, and other inorganic species in comparison to upgradient monitoring wells. Cadmium and selenium were above EPA Maximum Contaminant Levels (MCL) for drinking water in a number of the on-site monitoring and production wells (ref. 2). Table 1 shows highest reported contamination levels both on- and off-site.

Land burial of drummed vanadium pentoxide material, asbestos and "PCB filter" has occurred on-site (ref. 1). This practice has been discontinued and any currently produced hazardous waste is hauled off-site by a commercial hazardous waste hauler. Only general waste continues to be landfilled on site in a lined area. There are no available data suggesting that any of the solid waste land disposal practices has had any environmental impact.

On-site activities produce air emissions of dusts, sulfur oxides, and fluorides which are controlled by air pollution cleaning devices designed to meet state air requirements. Overt signs of air emissions, such as odors, smoke or dusts appeared to be limited to the facility property. In addition to the direct control activities mentioned above, EPA-accepted dispersion models to predict air concentrations of known pollutant source concentrations at the facility boundary lines have been used. For cadmium and fluorides, the major pollutants of concern, the predicted concentrations ranged from 40 to 40,000 times less than the American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit values (TLV's) for these pollutants. The model results have not been validated with actual ambient air sampling data.

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B. OFF-SITE CONTAMINATION

The Site Investigation results (ref. 2) showed elevated levels of selenium, cadmium, zinc and vanadium in an off-site spring (about 1,000 feet southwest of the site) and in the plant non-contact cooling water effluent discharged to surface water. No levels, however, exceeded Primary Drinking Water Standards (note that no standard exists for Vanadium). ~~This plant effluent serves as a small portion of irrigation water used to irrigate 4,300 acres of cropland (mostly grain crops).~~ *which is*

The EPA Site Investigation analysis of the Harris domestic well showed no further indication of fluoride contamination and the well met all drinking water standards. There was no readily observable evidence of off-site contamination from air pollutants or past solid waste disposal practices. No off-site ambient air or soil data were available for review.

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Table 1

Monsanto, Soda Springs
Groundwater Contamination
Highest Reported Concentrations
(mg/l)

	On-site	Off-site
Cadmium	5.52	.032
Selenium*	.775	.91
Vanadium	.153	.033
Fluoride	22.00	6-7**

* Estimated

** Reported to ATSDR during site visit.

C. QUALITY ASSURANCE AND QUALITY CONTROL

The results of this Preliminary Health Assessment are based largely on data developed for the EPA Site Inspection report dated April 1988. QA/QC measures were outlined but not detailed. The data are assumed to be accurate within the QA/QC procedures utilized.

D. PHYSICAL AND OTHER HAZARDS

The Monsanto plant is an active industrial operation with potential for accidents as would be expected at any similar facility. There is evidence of an active safety program throughout the facility.

PATHWAY ANALYSES

A. ENVIRONMENTAL PATHWAYS (FATE AND TRANSPORT)

Groundwater under the Monsanto site has been shown to contain elevated levels of metals and other ions. Contamination exists in two basalt hydrostratigraphic zones, an upper and lower basalt zone separated by a basalt aquitard. The upper zone has higher concentrations and more widely distributed contamination. On-site production wells are thought to heavily influence the flow of groundwater which generally flows to the south in the site area.

Drinking water for Soda Springs is taken from springs located hydraulically upgradient from the Monsanto site. Of the 22 wells registered within three miles of the site, it is not known how many would be located downgradient of the site or how they would be used. Only the Harris well, located immediately south of the site has been sampled.

There was no information available to indicate any significant off-site impact from air emissions from plant activities. There is potential for airborne dust and fine particulate migration during ore handling and earth moving operations. There was also no soil or ore leach-potential data available for review. Slag was analyzed for EP Toxicity and found not to exceed any of the Resource Conservation and Recovery Act (RCRA) standards for hazardous waste.

B. HUMAN EXPOSURE PATHWAYS

The presence of site-related compounds in on-site as well as off-site groundwater monitoring stations indicates an existing plume of contamination that is impacting local groundwater quality. No off-site potable water wells are known to be affected at this time. The Harris well which was contaminated with fluoride is no longer used for consumption. This well has returned to meeting all Safe Drinking Water Standards.

Two on-site wells are used for process and potable water. These wells show elevated levels of potassium (4.8 mg/l, estimated) and vanadium (.038 mg/l, estimated). Human contact through ingestion with known contaminated ground water appears to be limited to these on-site production wells used by Monsanto.

Most of the identified contaminants of concern for this site are not highly volatile and therefore would not be anticipated to present a major potential for human exposure via inhalation of the gaseous forms. Fugitive dusts from ore handling and processing, soil movement for on-site landfilling, and slag handling may present an exposure through inhalation, particularly on-site. There were a number of techniques, including air pollution control devices, negative air handling systems and ore pile treatment used at this facility to minimize this air emissions potential. On the day of ATSDR's site visit, fugitive emissions did not appear to present a significant potential for exposure on or off-site. However, more observation, possibly including ambient air sampling, under a variety of meteorological conditions would be needed to eliminate this as a potential pathway of concern.

Process emissions which include fluorides, sulfur oxides and particulates are regulated under State air quality requirements. In addition to implementing control technology to meet regulatory requirements, Monsanto models its point source emissions to determine potential impacts at their property line. For the worst case scenarios modelled to date, concentrations at the property line have ranged from one to four orders of magnitude under the ACGIH thresholds for the pollutants in question. Actual receptor site exposure data were not available.

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On-site well water used for showering or bathing could present a route for human exposure through dermal absorption. Similarly, fugitive dusts or airborne soil particles on exposed skin areas would serve as another potential for dermal exposure. Lack of chemical characterization of these sources of particulates precludes detailed evaluation of this mode of exposure.

The above identified human pathway exposures would appear to be limited largely to the on-site work population, given the sparse population in the immediate vicinity of the plant. Acute and/or long term public health consequences would be anticipated within the work force much earlier than for the general area public.

PUBLIC HEALTH IMPLICATIONS

Vanadium is found at elevated levels in production water ^{previously} used for drinking purposes by workers on-site and cadmium, selenium, vanadium and fluoride have previously been found at elevated levels in ground water off-site. Elevated levels of cadmium, selenium, and vanadium have been found in plant effluent (non-contact cooling water). Plant effluent is diluted with natural surface waters and used for irrigation purposes. Available evidence does not show vanadium in drinking water to be a problem (ref. 4). However, vanadium compounds as could be found in fugitive dust emissions could be irritating to the respiratory tract, eyes and skin, as well as, other body systems. Vanadium salts are considered extremely toxic by the oral route (ref. 7). Selenium and cadmium both have allowable MCL concentrations for drinking water of .01 mg/l. In the literature, human death has been attributed to ingestion of unknown amounts of selenium; in one case thought to be due to high levels of organic selenium contained in locally grown foods. Gastrointestinal distress has been reported to follow the ingestion of toxic amounts of sodium selenite. Varying neurological effects, including aches, pains, irritability, listlessness among others, were reported for humans experiencing elevated dietary intake of selenium. Selenium is not indicated as being carcinogenic. Epidemiological studies show an inverse relation between dietary selenium and human cancer occurrence (ref. 5).

Ingestion of excess amounts of cadmium (50 to 300 mg/kg body weight) can lead to death in humans from excess fluid loss. Adverse effects on kidney, liver, bone, testes, the immune system and the cardiovascular system may result from oral exposure to cadmium. Normal dietary cadmium intake averages 15 to 30 micrograms per day and is from water and plant materials, particularly grains and cereals (ref. 6).

Ingestion of water containing excess fluorides can lead to mottling of teeth in children, skeletal fluorosis, gastrointestinal symptoms and CNS involvement (ref. 4). Mottled teeth were reported for the Harris children who were exposed to fluoride in their well water.

Of the above contaminants, the Monsanto workforce is currently only exposed to Vanadium at levels up to approximately .038 mg/l, through the ingestion of contaminated groundwater. Currently, there are no data to suggest that this concentration would present a health problem.

There is no present evidence that the contaminated groundwater plumes underlying the Monsanto site are impacting ground water used for drinking water off-site. Mitigative measures taken to preclude further contamination of the groundwater, coupled with a normally low annual rainfall should reduce the potential for contaminating city water, which is reported to be upgradient of the contaminated plume, and the private wells south of the site.

Data regarding the fate of the non-contact cooling water discharged from the plant are also sparse. Documents indicate that cooling water is mixed and diluted with local surface water prior to being used to irrigate cropland. Data regarding concentrations of selenium and cadmium, or other metals, in the crops were not available for ATSDR review. Limited air emissions data did not allow a detailed assessment of public health impact; however, as mentioned previously, it would appear that the measures taken to control emissions and comply with State requirements have been effective and largely limit any obvious impacts to the site itself. Also, the facility is located in a very sparsely populated part of town. Finally, because of the lack of on-site soil characterization data, no judgments have been made with respect to impact of fugitive dusts arising from on-site land disposal operations.

CONCLUSIONS

This site is of potential public health concern because of the risk to human health resulting from possible exposure to hazardous substances at concentrations that may result in adverse health effects. As described above, exposure to a number of inorganic compounds may have occurred or may still occur through the ingestion, inhalation or dermal contact with contaminated groundwater or plant air/site fugitive dust emissions.

The lack of actual off-site air characterization data precludes further analysis of the impact on public health through this media. Similarly lack of data characterizing irrigation water or concentrations of metals in crops precludes further examination of the food chain. It should be noted, however, that neither of these potential routes of exposure were raised as a public concern during the ATSDR site visit.

by EPA representatives
or the company?

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RECOMMENDATIONS

1. Continue to sample the existing monitoring well network, including the Harris well to track the contaminated plume migration and concentration. Being directly in the path of plume migration, the Harris well should serve as a particularly good indicator of off-site contamination. Sampling should continue until such time that a clear and statistically supportable conclusion can be drawn to show that the potential for contaminant migration from on-site to off-site areas is no longer significant.
2. Several domestic drinking water wells upgradient and downgradient from the site should be identified for annual sampling to see if there is any notable difference in water quality.
3. Irrigation water with and without the cooling water effluent should be analyzed to see if there is any significant difference in the concentration of the metals of concern. If there is a significant difference, crop plant uptake and concentration of these metals should be investigated to see if there may be any effect on the food chain.
4. Monsanto should continue their efforts in evaluating the potential for impact from air emissions, including fugitive dusts, from their plant activities.
5. In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, the Monsanto site has been evaluated for appropriate follow-up with respect to health effects studies. Although there are indications that human exposure to on-site/off-site contaminants in the groundwater may be currently occurring/may have occurred in the past, this site is not being considered for follow-up health studies at this time because of the apparently limited likelihood of off-site contamination of potable water and the lack of data to show that the contaminants in the plant potable water present a human health problem. Also, the existing monitoring program, coupled with continuing corrective measures should provide a good margin of safety to detect potential increases or migration of contamination before they become a public health problem.

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